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BURROWING OWL POPULATION-TREND SURVEYS IN SOUTHERN ALBERTA: 1991–2000

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ABSTRACT.—In Alberta, standardized diurnal call-playback surveys for Western Burrowing Owls (*Athene cunicularia hypugaea*) were conducted between 1991–2000 near the town of Hanna, and between 1993–2000 near the town of Brooks. In most years, the Brooks and Hanna surveys encompassed 10 360 ha and 7060 ha, respectively. Both survey areas are located within the historical breeding distribution of Burrowing Owls in predominantly native mixed-grass prairie habitat. The Hanna surveys indicated that the density of nests ($\bar{x}$ = 13.7 nests per 100 km^2, range = 2.8–32.6) declined significantly between 1991 and 2000. The decline in the Hanna area was most pronounced between 1991 (32.6 nests/100 km^2) and 1997 (2.8 nests/100 km^2) and recent surveys have found few nests. The Brooks surveys indicate that the density of nests ($\bar{x}$ = 8.9 nests/100 km^2, range = 1.9–13.5), although lower than Hanna, did not decrease during the course of the surveys. The significant decline in Hanna is most likely indicative of the contraction of the northern edge of the breeding distribution of Burrowing Owls in Alberta and suggests that the population will soon become extirpated from that area.

KEY WORDS: *Burrowing Owl;* Athene cunicularia; *monitoring; population trend; survey; call-playback; Alberta; Canada.*

Estudios de la tendencia de la población del Búho Cavador en el sur de Alberta: 1991–2000

RESUMEN.—En Alberta, fueron llevados a cabo estudios diurnos estandarizados por medio de llamados con sonidos pregrabados para los Búhos Cavadores Occidentales (*Athene cunicularia hypugaea*) entre 1991–2000 cerca de la ciudad de Hanna, y entre 1993–2000 cerca de la ciudad de Brooks. En la mayoría de años, los estudios de Brooks y Hanna abarcaron 10 360 ha y 7060 ha, respectivamente. Ambas áreas

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de estudio están localizadas dentro de la distribución de apareamiento histórica de los Búhos Cavadores en el hábitat predominantemente nativo de praderas de pastos mixtos. Los estudios de Hanna indican que la densidad de nidos ($\bar{x}$ = 13.7 nidos por 100 km^2, rango = 2.8–32.6) declinó significativamente entre 1991 y el 2000. El declive en el área de Hanna fue mas pronunciado entre 1991 (32.6 nidos/100 km^2) y 1997 (2.8 nidos/100 km^2) y los estudios recientes han encontrado pocos nidos. Los estudios en Brooks indican que la densidad de nidos ($\bar{x}$ = 8.9 nidos/100 km^2, rango = 1.9–13.5), aunque mas baja que la de Hanna, no decreció durante el curso de los estudios. El declive significativo en Hanna probablemente es mas indicativo de la contracción del borde norte de la distribución de los apareamientos de los Búhos Cavadores en Alberta y sugiere que la población pronto comenzará a ser extirpada de esa área.

[Traducción de Victor Vanegas y César Márquez]

Western Burrowing Owls (*Athene cunicularia hypugaea*) show a strong association with Great Plains habitat on the Canadian breeding grounds, and in Alberta they nest in the Mixed-grass Ecoregion in the southeastern corner of the province. Across North America, native mixed-grass prairie has been converted to agricultural cropland or non-native planted pasture, and less than 33% currently remains intact (World Wildlife Fund 1989). Conversion to cropland has been particularly severe in Canada, as only 24% of the original prairie habitat remains (Trottier 1992). In Alberta, the Mixed-grass Ecoregion comprises almost 12% of the province, of which more than half has been significantly altered by agriculture in the last century (Strong and Leggat 1992).

Evidence from private landowners, censuses, and individual research projects indicate that Burrowing Owl populations have declined in every historically-occupied province in Canada (Wedgwood 1978, Haug and Didiuk 1991, Wellicome and Haug 1995, Hjertaas 1997, James et al. 1997, Wellicome 1997). Monitoring in Manitoba has shown a decline from 34 to 1 nest between 1987–96 (De Smet 1997). From 1997–2000 the number of nests found in Manitoba fluctuated between 1–3 nests, so Burrowing Owls are on the verge of extirpation in that province (K. De Smet pers. comm.). Continued captive breeding and reintroduction efforts seem to have maintained the extremely small population that remains in British Columbia, near Kamloops, but the wild provincial population was probably extirpated since the early-1980s (Leupin and Low 2001). Because of these declines, Burrowing Owls have been listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as threatened since 1978 (Wedgwood 1978) and as endangered since 1995 (Wellicome and Haug 1995). The following is a summary of results based from six standardized surveys in the Hanna area between 1991–2000 and seven surveys in the Brooks area between 1993–2000.

METHODS

Diurnal call-playback surveys were first initiated in 1991 to determine Burrowing Owl density and abundance in Alberta. Survey blocks were established in habitat containing more than 75% native prairie near Hanna in 1991, and 135 km south near Brooks in 1993. Both survey areas are within the historical breeding range of Burrowing Owls in Alberta. Continued monitoring of these standardized survey blocks allows for an examination of trends of two populations over most of the last decade. Prior to implementation of these surveys, no standardized survey protocol existed for Burrowing Owls. We collected survey data from the Hanna area during 6 yr (between 1991–2000) and during 7 yr from the Brooks area (between 1993–2000).

The survey protocol is designed to locate active nests within a sample of quarter-sections. Searches are conducted one quarter-section (64.7 ha each) at a time by two stationary observers, using all-terrain vehicles to move between quarter-sections. The quarter-section was chosen as the unit of size for surveys because fences, roads, and edges of agricultural fields delineated some of the quarter-section boundaries. Pairs of observers used binoculars, spotting scopes, and broadcasts of a territorial male breeding call while conducting surveys in June–July Surveys conducted at this time of year record nests prior to fledging, yet ensure that detection of owls is not greatly reduced by seasonal vegetation growth. Playback of the territorial male breeding call has been shown to be effective at increasing the detection of owls (Haug and Didiuk 1993). The pair of observers stood ca. 200–500 m apart, choosing the best vantage points (usually hilltops) so that the greatest area of the quarter-section was visible. Observers sometimes stood on their all-terrain vehicle to increase their field of view. Different observers surveyed the same quarters in consecutive years to reduce bias that might result from observer memory. Recorded breeding calls were broadcast from a position in the upwind third of the quarter-section, thus ensuring the call reached the entire quarter-section. The quarter-sections were surveyed in a downwind-to-upwind sequence to reduce the potential for downwind owls to habituate to the breeding call-playback. Generally, observation points were at the same locations across years because we used the higher hilltops for sampling in quarter-sections. However, pre-

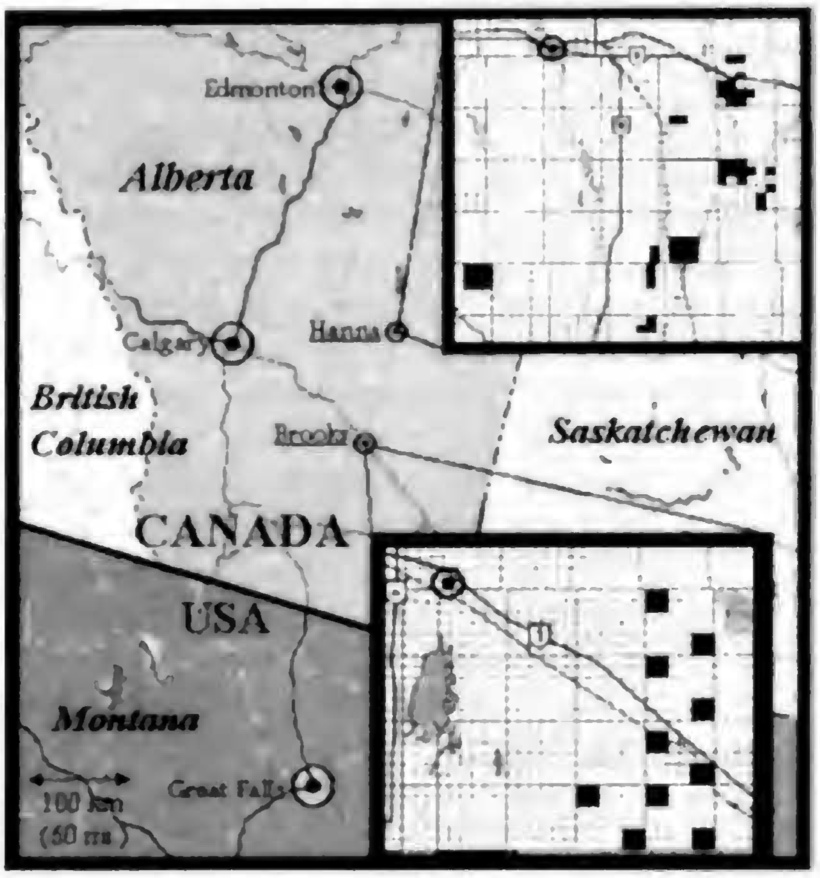

Figure 1. Locations of Hanna and Brooks survey areas in Alberta. Black squares in insets show areas surveyed for Burrowing Owls, and squares in grid are each 1.6 km by 1.6 km (one section of land).

vailing wind direction affected the selection of observation points and resulted in some variation in sampling points across years. When observers encountered a cultivated quarter-section, they scanned for owls from the perimeter while driving approximately 40 km/hr. Although driving the perimeter of cultivated land may increase search effort by increasing time spent surveying, nests were never located in any cultivated land over the course of the surveys. Because 9–10% of the quarter-sections surveyed were partially or entirely under cultivation, seeded pasture, or nonnative hay, the habitat surveyed reflects the fragmented habitat present in Alberta, albeit at a lower level of fragmentation than the provincial average for the Mixed-grass Ecoregion.

Quarter-sections were surveyed in three consecutive 5-min observation intervals during which we emphasized sighting owls. During the first 5-min interval, 360° silent scanning allowed for initial observations of owls, potential nests, and roosts. This first passive interval may also have allowed any disturbance from the all-terrain vehicle to subside and thus increase the response of the owl to the breeding call-playback. The observer in the upwind position then broadcast a male breeding call for the next 5 min while continuing the 360° scan. The observers would complete the survey after a final 5-min silent observation interval and 360° scan. Since all owls were observed in the first 10 min, the final 5-min interval was dropped from the 2000 Hanna survey and the 1999 and 2000 Brooks surveys.

The quarter-sections in Hanna (Fig. 1) were first selected based on observations in a previous study (J. Schmutz unpubl. data) that evaluated the effectiveness of call-playback survey methodology. Thus, sites were not randomly selected and survey blocks were not evenly distributed across the landscape. Thirty-two of 109 quarter-sections were chosen for the survey because they had supported owls in 1990 and earlier. Except in 1994 (81 quarter-sections) and 2000 (76 quarter-sections), all 109 quarter-sections were surveyed each year in Hanna (Table 1). The fewer number of quarter-sections surveyed in 2000 was the result of a single private landowner who denied observers access to his land.

Quarter-sections were uniformly distributed in Brooks in 10 survey blocks, each containing 16 quarter-sections (Fig. 1). These blocks were systematically located in the northwest and southeast corners of five adjacent townships without prior knowledge of owl presence or absence. Except in 1993 (128 quarter-sections), all 160 quarter-sections were surveyed each year in Brooks (Ta-

Table 1. Number of Burrowing Owl nests observed, nest density, percent change in nest density from previous year of survey, and number of quarter-sections surveyed in the Hanna and Brooks areas.

	SURVEY AREA							
	HANNA				BROOKS			
YEAR	NO. OF NESTS	PER 100 km²	PERCENT CHANGE	NO. OF 1/4's	NO. OF NESTS	PER 100 km²	PERCENT CHANGE	NO. OF 1/4's
1991	23	32.6	—	109	—	—	—	—
1992	—	—	—	—	—	—	—	—
1993	14	19.8	−39	109	6	7.2	—	128
1994	9	17.2	−13	81	2	1.9	−73	160
1995	—	—	—	—	12	11.6	500	160
1996	—	—	—	—	—	—	—	—
1997	2	2.8	−83	109	14	13.5	17	160
1998	4	5.7	100	109	10	9.7	−29	160
1999	—	—	—	—	10	9.7	0	160
2000	2	4.1	−28	76	9	8.7	−10	160

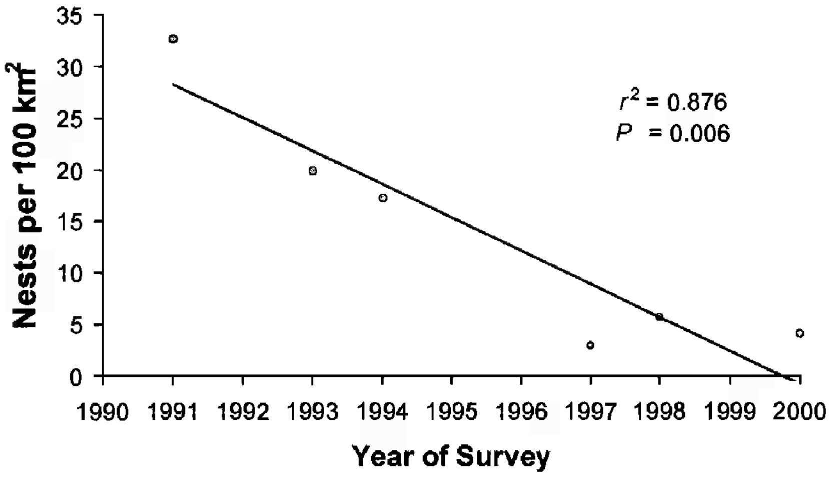

Figure 2. Nest densities and linear regression ($F = 28.1$, $r^2 = 0.88$, $P < 0.01$) line for Hanna survey area 1991–2000.

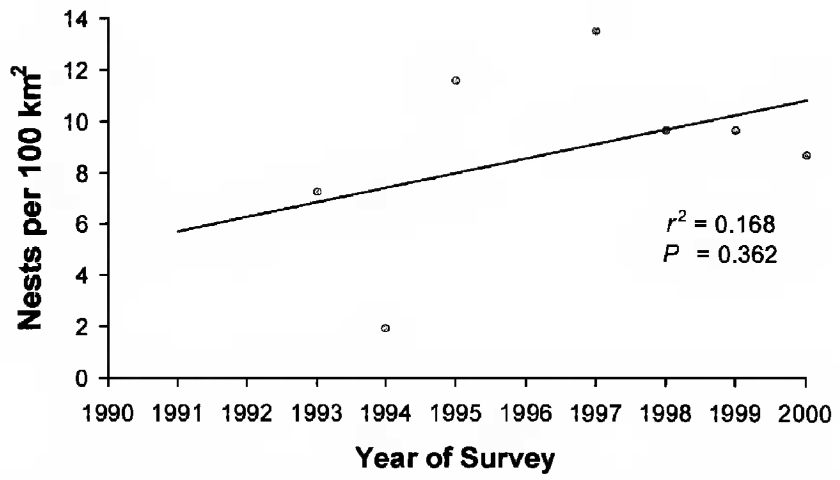

Figure 3. Nest densities and linear regression ($F = 1\ 0$, $r^2 = 0.17$, $P = 0.36$) line for Brooks survey area 1993–2000.

ble 1). Half of the area that was not surveyed in 1993 was substandard mixed-grass prairie and had been broken and seeded. No nests were observed in those quarter-sections during any other year of the survey. Thus, the effect of excluding this area in 1993 on the results of the Brooks survey was likely negligible.

Every owl observation was investigated for evidence of nesting before proceeding to the next quarter-section in the survey. Evidence for nesting included: 1) the presence of juvenile owls; 2) a pair of owls (pair bonds usually do not endure unless a brood is raised); or 3) one owl and abundant nesting material (manure or dung), whitewash, pellets, and prey remains present, as well as loosened soil on the burrow mound.

Certain weather conditions affect owl behavior (e.g., crouching low in a burrow) and reduce the probability of owl detection. Therefore, surveys were not conducted when: 1) temperatures were >30°C (surveys were started shortly after sunrise and generally did not continue into mid-afternoon); 2) wind speeds were >20 km/hr; or 3) it was raining. Nests found outside of the prescribed survey area were not included in this analysis.

RESULTS

Reduction of the area covered by the surveys in 1993, 1994, and 2000, large variation in the number of nests per quarter-section (because of the semicolonial nature of nesting owls), and the high percentage (80–98%) of quarter-sections surveyed that contained no nests, confound population trend analysis at the quarter-section scale. Population analysis was therefore conducted using linear regression of annual nest densities for the whole of each survey area.

Between 1991 and 2000, the number of nests observed in the Hanna survey decreased substantially, while the number of nests observed in the Brooks survey between 1993 and 2000 increased (Table 1). The mean number of nests found during the surveys was nine for both survey areas. The annual nest density in the Hanna surveys showed a significant ($P < 0.05$) negative trend closely fitting the regression line ($F = 28.1$, $P < 0.01$, $r^2 = 0.88$; Fig. 2), but there was no significant relationship in nest density over time in the Brooks area ($F = 1.0$, $P = 0.36$, $r^2 = 0.17$; Fig. 3). The mean nest density in Hanna was higher but more variable (13.7 nests/100 km^2, SE = 4.77, $N = 6$) than in Brooks (8.9 nests/100 km^2, SE = 1.39, $N = 7$) due to the high densities in the early years of the Hanna survey.

DISCUSSION

It could be argued that results should be calculated using only quarter-sections surveyed consistently across all years. Eliminating quarter-sections not surveyed across all years of the survey reduces the number of quarter-sections in Hanna by more than 50% (109 to 53), and by 20% (160 to 128) in Brooks. Eliminating these quarter-sections reduces the number of nests located in the surveys by 1–3 nests/yr, but unreasonably inflates the estimated nest densities by 53% in Hanna and 18% in Brooks. This effect is especially evident in higher density years (e.g., nest density in Hanna in 1991 is nearly doubled from 32.6 to 61.2 nests/100 km^2). However, either including or excluding those quarter-sections not surveyed in all years made little difference to the slopes of linear regression lines for Hanna or for Brooks.

The initial decline in the number of nests located during early surveys in Hanna (1991–93) may be biased, as 29% of these quarter-sections were established with prior knowledge of owl presence. Starting the surveys on occupied quarter-sections could initially inflate the estimated decline (Rich 1984); however, most quarter-sections adjacent to formerly occupied quarters were also included in the Hanna survey, decreasing the likelihood that owls that dispersed even moderate distances between years would be subsequently missed. It is unlikely that the continued decline in later survey years and the dramatic difference in annual nesting densities resulted from non-random quarter-section selection. The negative slope of the Hanna regression lines concur with trends shown over larger areas by other population estimates in Alberta (Wellicome 1997), Saskatchewan (Hjertaas 1997), and Manitoba (De Smet 1997). Unless this trend is reversed, the Burrowing Owl population near Hanna will likely become extirpated.

Although annual nest densities in Brooks were much lower than those in Hanna between 1991–94, nest densities have not declined overall in Brooks. The approximately stable population trend in Brooks is the only non-negative population trend that has ever been documented in Canada. Future surveys may ascertain if the Brooks population remains relatively stable at a lower density than in the Hanna area or if the Brooks population will decline as the northern edge of Burrowing Owl range continues to contract southward. Ongoing research in areas adjacent to the Brooks survey quarter-sections indicates that immigration and emigration play a large factor in maintaining this population, as few banded owls have returned to the study site (D. Shyry unpubl. data). If few owls return after migration, breeding and natal dispersal must be long-distance, or else mortality on the migration routes and overwintering sites must be high.

Nest densities determined by the 2000 Brooks surveys were very similar to nest densities determined independently by random point-count surveys conducted across southeastern Alberta. Although the random point counts surveyed five times more area than the Brooks survey, the resulting nest densities (8.63 nests/100 km^2 in 2000) closely resemble densities determined by the Brooks surveys (D. Scobie unpubl. data). This concurrence indicates that the Brooks surveys are likely a representative subsample of densities south of the contracting northern limit of the Burrowing Owl breeding range.

Burrowing Owl population trends from Hanna and Brooks were derived from surveys of large areas with a standardized protocol that has not been applied in any other jurisdiction. Given that the area of mixed-grass prairie has not decreased notably in either of the two survey areas over the past decade, yet population trends differ considerably, it is unclear if differing land-management practices (see Clayton and Schmutz 1999), other environmental factors (e.g., precipitation, prey abundance, predator abundance), owl behaviors (i.e., dispersal, immigration, emigration), and/or large-scale (i.e., continental) population declines are influencing the separate trends. In light of its proximity to the northern limit of the Burrowing Owl breeding range, Hanna's significantly declining nest densities may result from the contraction of the breeding range (Wellicome 1997), which could be a symptom of a shrinking continental population.

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